DREDGED MATERIAL RESEARCH PROGRAM

MISCELLANEOUS PAPER D-77-4

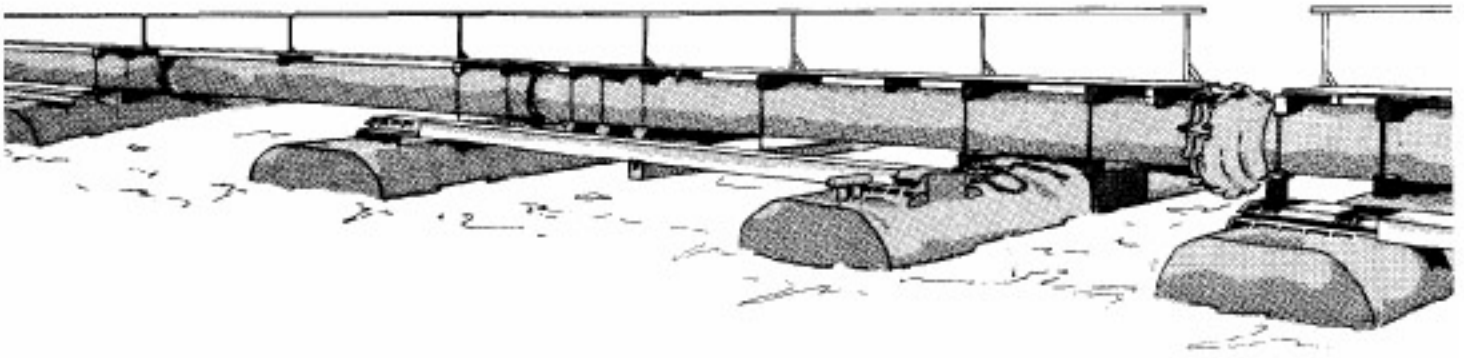
AN EVALUATION OF PROGRESSIVE TRENCHING AS A TECHNIQUE FOR DEWATERING FINE-GRAINED DREDGED MATERIAL

by

Michael R. Palermo

Environmental Effects Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

December 1977
Final Report



Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under DMRP Work Unit No. 5A08

Destroy this report when no longer needed. Do not return it to the originator.

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESYV

31 January 1978

SUBJECT: Transmittal of Miscellaneous Paper D-77-4

TO: All Report Recipients

1. The report transmitted herewith represents the results of a study of a dredged material dewatering concept evaluated as part of Task 5A (Dredged Material Densification) of the Corps of Engineers' Dredged Material Research Program (DMRP). This task is part of the Disposal Operations Project of the DMRP and is concerned with developing and/or testing promising techniques for dewatering and/or densifying (i.e., reducing the volume of) dredged material using physical, biological, and/or chemical techniques prior to, during, and/or after placement in containment areas.

2. The rapidly escalating requirements for land for the confinement of dredged material, often in urbanized areas where land values are high, dictated that significant priority within the DMRP be given to research aimed at extending the useful life of existing or proposed containment facilities. While increased life expectancy can be achieved to some extent by improved site design and operation and to a greater extent by removing dredged material for use elsewhere, the attractive approach being considered under Task 5A is to densify the in-place dredged material. Densification of the material would not only increase site capacity but also result in an area that would be more attractive for various subsequent uses because of the improved engineering properties of the material.

3. The objective of this study (Work Unit 5A08) was to evaluate the effects of progressive trenching on the dewatering and drying of fine-grained dredged material in confined disposal areas using the Riverine Utility Craft (RUC) and conventional trenching equipment. The study consisted of an initial field and laboratory testing program, construction of a surface drainage system within a disposal area using the progressive trenching approach, evaluation of trenching equipment, and a field instrumentation and monitoring program to test the effectiveness of the progressive trenching technique. The investigation was conducted by the Environmental Engineering Division of the Waterways Experiment Station, Environmental Effects Laboratory.

WESYV 31 January 1978
SUBJECT: Transmittal of Miscellaneous Paper D-77-4

4. Laboratory tests included determination of physical and engineering properties of the dredged material. Conventional consolidation tests were successfully performed on undisturbed dredged material samples, and a linear shrinkage laboratory test procedure was developed to evaluate potential shrinkage effects due to drying. Results of the laboratory testing program were used in estimating potential densification of dredged material due to progressive trenching.

5. The concept of progressive trenching is simply to provide drainage trenches for the removal of rain water and other surface water that may enter a containment area. Removal of this water allows the total evaporation potential available at the site to remove water from the material as opposed to the net evaporation (net evaporation equals total evaporation minus rainfall). The surface drainage system was constructed within a 28-hectare study area using both conventional and specialized equipment. Trenches were initially constructed using the RUC, an amphibious vehicle employing the Archimedean screw principle as a means of propulsion. Conventional draglines and flotation draglines that employed a special pontoon tracking mechanism were also used. A progressive trenching approach was used to deepen the surface drainage system using the various types of equipment as conditions warranted as the depth of desiccation cracks increased. It was found that construction of surface drainage systems within disposal areas was operationally feasible.

6. Effects of the progressive trenching efforts were evaluated by monitoring dredged material surface elevations and dredged material groundwater elevations within the study area. Field data indicated that the surface drainage system was effective in lowering the dredged material groundwater table through evaporation. An average surface settlement of approximately 0.23 m was achieved through the study area. Economic evaluations indicated that the progressive trenching operations were economically feasible.

7. The results of this study will be included as part of the site report for all tests conducted at the Upper Polecat Bay Disposal Site in Mobile, Alabama. The results of this study were also used in preparing final dewatering guidelines to be contained in the Task 5A synthesis report and engineering manual. This report may be used for interim guidance on the progressive trenching method for densifying dredged material.

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Miscellaneous Paper D-77-4
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): AN EVALUATION OF PROGRESSIVE TRENCHING AS A TECHNIQUE FOR DEWATERING FINE-GRAINED DREDGED MATERIAL

5. TYPE OF REPORT & PERIOD COVERED: Final report

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Michael R. Palermo

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
U. S. Army Engineer Waterways Experiment Station
Environmental Effects Laboratory
P. O. Box 631, Vicksburg, Miss. 39180

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: DMRP Work Unit No. 5A08

11. CONTROLLING OFFICE NAME AND ADDRESS:
Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

12. REPORT DATE: December 1977

13. NUMBER OF PAGES: 174

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Consolidation (Soils)	Dredging
Dewatering	Riverine Utility Craft
Disposal areas	Soil shrinkage
Polecat Bay, AL	Surface drainage
Dredged material	Trenching

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The results of a study conducted within a confined disposal area concerning the effects of progressive trenching on dredged material dewatering and drying are documented. The study consisted of an initial field and laboratory testing program, construction of a surface drainage system within the disposal area using a progressive trenching approach, evaluation of trenching equipment, and a field instrumentation and monitoring program.

(Continued)

20. ABSTRACT (Continued).

Laboratory testing included determination of physical and engineering properties of the dredged material. Conventional consolidation tests were successfully performed on undisturbed dredged material samples and a linear shrinkage laboratory test procedure was developed to evaluate potential shrinkage effects due to drying. Results of the laboratory testing program were used in estimating potential densification of dredged material due to progressive trenching.

A surface drainage system was constructed within a 60-acre study area using both conventional and specialized equipment. Trenches were initially constructed using the Riverine Utility Craft (RUC), an amphibious vehicle employing the Archimedes screw principle as a means of propulsion. Conventional dragline equipment and flotation draglines which employed a special pontoon tracking mechanism were also used. A progressive trenching approach was employed to deepen the surface drainage system using the various types of equipment as conditions warranted. It was found that construction of surface drainage systems within disposal areas is operationally feasible.

Effects of the progressive trenching efforts were evaluated by monitoring dredged material surface elevations and dredged material groundwater elevations within the study area. Field data indicated that the surface drainage system was effective in lowering the dredged material groundwater table. An average surface settlement of approximately 0.75 ft was achieved throughout the study area. Economic evaluations indicated that progressive trenching operations were economically feasible with both comparatively low unit cost and favorable benefit/cost ratio.

DREDGED MATERIAL RESEARCH PROGRAM

MISCELLANEOUS PAPER D-77-4

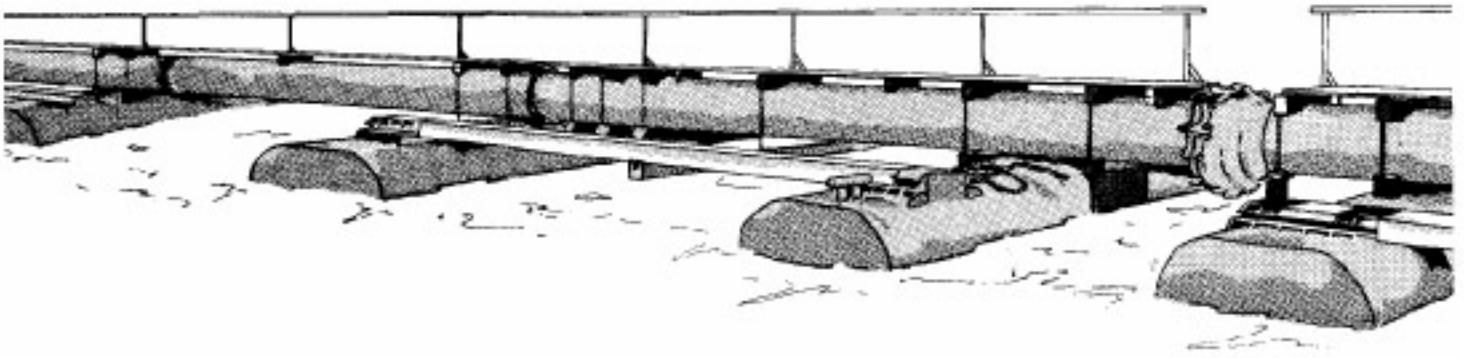
AN EVALUATION OF PROGRESSIVE TRENCHING AS A TECHNIQUE FOR DEWATERING FINE-GRAINED DREDGED MATERIAL

by

Michael R. Palermo

Environmental Effects Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

December 1977
Final Report



Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under DMRP Work Unit No. 5A08

Destroy this report when no longer needed. Do not return it to the originator.

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESYV

31 January 1978

SUBJECT: Transmittal of Miscellaneous Paper D-77-4

TO: All Report Recipients

1. The report transmitted herewith represents the results of a study of a dredged material dewatering concept evaluated as part of Task 5A (Dredged Material Densification) of the Corps of Engineers' Dredged Material Research Program (DMRP). This task is part of the Disposal Operations Project of the DMRP and is concerned with developing and/or testing promising techniques for dewatering and/or densifying (i.e., reducing the volume of) dredged material using physical, biological, and/or chemical techniques prior to, during, and/or after placement in containment areas.

2. The rapidly escalating requirements for land for the confinement of dredged material, often in urbanized areas where land values are high, dictated that significant priority within the DMRP be given to research aimed at extending the useful life of existing or proposed containment facilities. While increased life expectancy can be achieved to some extent by improved site design and operation and to a greater extent by removing dredged material for use elsewhere, the attractive approach being considered under Task 5A is to densify the in-place dredged material. Densification of the material would not only increase site capacity but also result in an area that would be more attractive for various subsequent uses because of the improved engineering properties of the material.

3. The objective of this study (Work Unit 5A08) was to evaluate the effects of progressive trenching on the dewatering and drying of fine-grained dredged material in confined disposal areas using the Riverine Utility Craft (RUC) and conventional trenching equipment. The study consisted of an initial field and laboratory testing program, construction of a surface drainage system within a disposal area using the progressive trenching approach, evaluation of trenching equipment, and a field instrumentation and monitoring program to test the effectiveness of the progressive trenching technique. The investigation was conducted by the Environmental Engineering Division of the Waterways Experiment Station, Environmental Effects Laboratory.

WESYV 31 January 1978
SUBJECT: Transmittal of Miscellaneous Paper D-77-4

4. Laboratory tests included determination of physical and engineering properties of the dredged material. Conventional consolidation tests were successfully performed on undisturbed dredged material samples, and a linear shrinkage laboratory test procedure was developed to evaluate potential shrinkage effects due to drying. Results of the laboratory testing program were used in estimating potential densification of dredged material due to progressive trenching.

5. The concept of progressive trenching is simply to provide drainage trenches for the removal of rain water and other surface water that may enter a containment area. Removal of this water allows the total evaporation potential available at the site to remove water from the material as opposed to the net evaporation (net evaporation equals total evaporation minus rainfall). The surface drainage system was constructed within a 28-hectare study area using both conventional and specialized equipment. Trenches were initially constructed using the RUC, an amphibious vehicle employing the Archimedean screw principle as a means of propulsion. Conventional draglines and flotation draglines that employed a special pontoon tracking mechanism were also used. A progressive trenching approach was used to deepen the surface drainage system using the various types of equipment as conditions warranted as the depth of desiccation cracks increased. It was found that construction of surface drainage systems within disposal areas was operationally feasible.

6. Effects of the progressive trenching efforts were evaluated by monitoring dredged material surface elevations and dredged material groundwater elevations within the study area. Field data indicated that the surface drainage system was effective in lowering the dredged material groundwater table through evaporation. An average surface settlement of approximately 0.23 m was achieved through the study area. Economic evaluations indicated that the progressive trenching operations were economically feasible.

7. The results of this study will be included as part of the site report for all tests conducted at the Upper Polecat Bay Disposal Site in Mobile, Alabama. The results of this study were also used in preparing final dewatering guidelines to be contained in the Task 5A synthesis report and engineering manual. This report may be used for interim guidance on the progressive trenching method for densifying dredged material.

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Miscellaneous Paper D-77-4
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): AN EVALUATION OF PROGRESSIVE TRENCHING AS A TECHNIQUE FOR DEWATERING FINE-GRAINED DREDGED MATERIAL

5. TYPE OF REPORT & PERIOD COVERED: Final report

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Michael R. Palermo

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
U. S. Army Engineer Waterways Experiment Station
Environmental Effects Laboratory
P. O. Box 631, Vicksburg, Miss. 39180

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: DMRP Work Unit No. 5A08

11. CONTROLLING OFFICE NAME AND ADDRESS:
Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

12. REPORT DATE: December 1977

13. NUMBER OF PAGES: 174

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Consolidation (Soils)	Dredging
Dewatering	Riverine Utility Craft
Disposal areas	Soil shrinkage
Polecat Bay, AL	Surface drainage
Dredged material	Trenching

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The results of a study conducted within a confined disposal area concerning the effects of progressive trenching on dredged material dewatering and drying are documented. The study consisted of an initial field and laboratory testing program, construction of a surface drainage system within the disposal area using a progressive trenching approach, evaluation of trenching equipment, and a field instrumentation and monitoring program.

(Continued)

20. ABSTRACT (Continued).

Laboratory testing included determination of physical and engineering properties of the dredged material. Conventional consolidation tests were successfully performed on undisturbed dredged material samples and a linear shrinkage laboratory test procedure was developed to evaluate potential shrinkage effects due to drying. Results of the laboratory testing program were used in estimating potential densification of dredged material due to progressive trenching.

A surface drainage system was constructed within a 60-acre study area using both conventional and specialized equipment. Trenches were initially constructed using the Riverine Utility Craft (RUC), an amphibious vehicle employing the Archimedes screw principle as a means of propulsion. Conventional dragline equipment and flotation draglines which employed a special pontoon tracking mechanism were also used. A progressive trenching approach was employed to deepen the surface drainage system using the various types of equipment as conditions warranted. It was found that construction of surface drainage systems within disposal areas is operationally feasible.

Effects of the progressive trenching efforts were evaluated by monitoring dredged material surface elevations and dredged material groundwater elevations within the study area. Field data indicated that the surface drainage system was effective in lowering the dredged material groundwater table. An average surface settlement of approximately 0.75 ft was achieved throughout the study area. Economic evaluations indicated that progressive trenching operations were economically feasible with both comparatively low unit cost and favorable benefit/cost ratio.